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(71) Applicant(s)
Fichtel & Sachs AG

(Incorporated in the Federal Republic of Germany)

Ernst-Sachs-Strasse 62, 97419 Schweinfurt,
Federal Republic of Germany

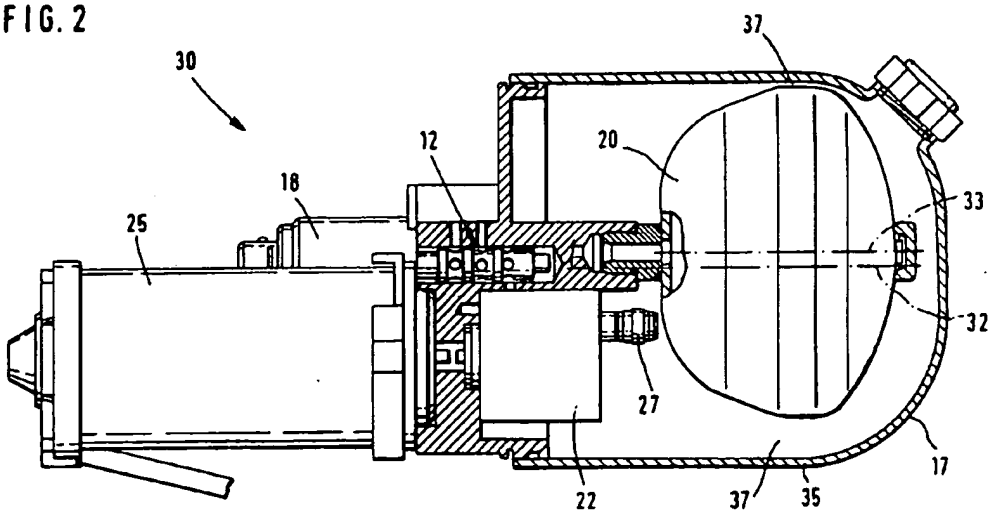
(72) Inventor(s)
Lutz Leimbach
Jens Dorfschmid

(74) Agent and/or Address for Service
Barker, Brettell & Duncan
138 Hagley Road, Edgbaston, BIRMINGHAM,
B16 9PW, United Kingdom

(54) Fluid-Pressure Actuating System

(57) A fluid-pressure actuating system has a pump (22) with its suction side in a fluid reservoir (17), the pump (22) being operated by drive means (25). An accumulator (20) supplied from the pump (22) supplies pressure fluid to an actuator (5) under the control of a control valve (12). In order to reduce the size of the system, at least one of the drive means (25), the accumulator (20) and the control valve (12) is incorporated in the reservoir (17). The reduction in size of the system by the removal of these components from their usual positions is much greater than the increase in size of the reservoir (17) needed to compensate for the loss of fluid capacity.

FIG. 2



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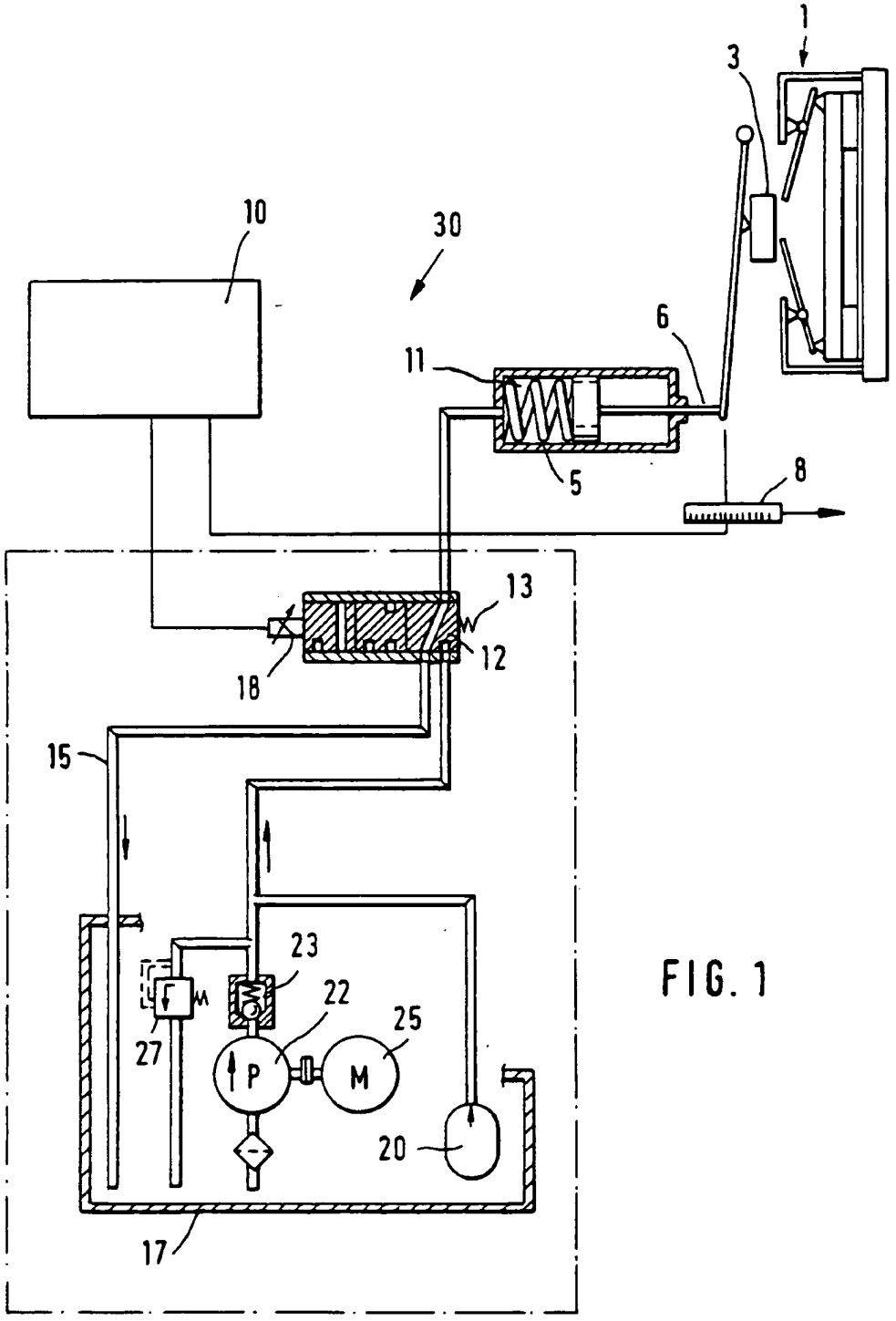

FIG. 1

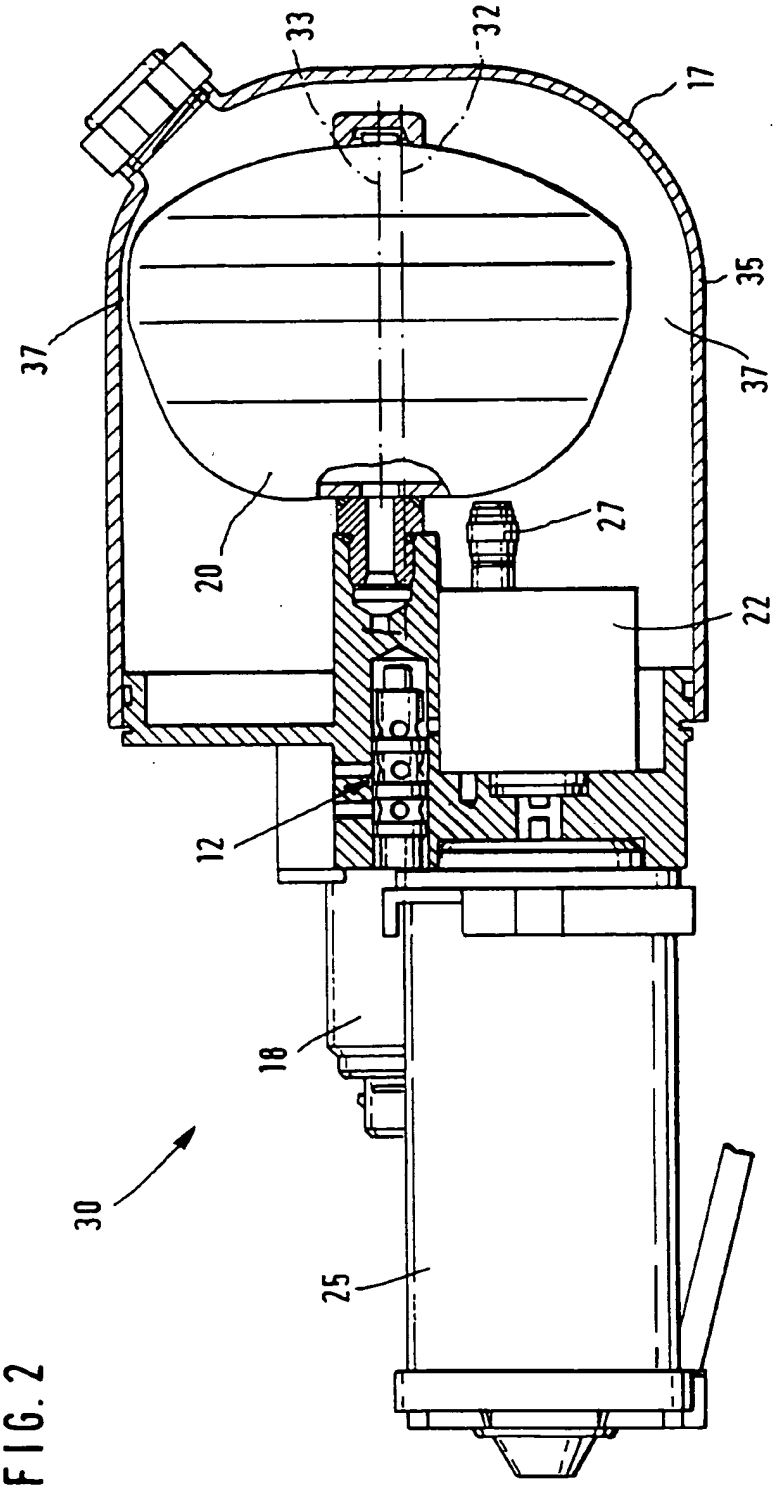

FIG. 2

FLUID-PRESSURE ACTUATING SYSTEM

The invention relates to a fluid-pressure actuating system of the kind comprising a pump having a suction side in a reservoir for fluid, drive means for operating the pump, an accumulator supplied from a delivery side of the pump, a fluid-pressure actuator means and a control valve for connecting the actuator means to the accumulator.

Such an actuating system is commonly used in motor vehicles to operate a friction clutch. The actuator means may then comprise a master cylinder acting on a clutch withdrawal mechanism through a slave cylinder.

DE-A-42 37 853 shows an actuating system of the kind set forth, in which the drive means comprises an electric motor, and the pump delivery side is connected to the accumulator through a pressure-limiting valve. The control valve comprises an electrically actuated three/three-way valve connected to a master cylinder which acts through a slave cylinder on a withdrawal mechanism for the clutch of a vehicle.

In DE-A-42 37 853 the reservoir and pump are contained in a housing. The accumulator is secured to the housing in such a way that it projects significantly beyond the housing. Further, an electromagnetic actuator for actuating the control valve, and the electric motor are also mounted on the housing. As all these are components of substantial volume they substantially increase the structural size of the system. This can cause problems in the installation of the system in a vehicle, in particular where, in a compact motor vehicle, only a small amount of space is available for such a system. In the most extreme case, where the

space available in the vehicle is simply insufficient, the actuating system cannot be installed.

The invention is based on solving the problem of providing a fluid-pressure-actuating system of the kind set forth which can be installed without problems, even in vehicles which have extremely limited space available for the installation of such a system.

According to the present invention, in a fluid-pressure actuating system of the kind set forth, at least one of the components comprising the drive means, accumulator and control valve is at least partially incorporated in the reservoir.

This arrangement significantly reduces the space required by the actuating system. The incorporation of at least part of a component into the existing reservoir means that the component requires less space outside the reservoir. The consequent reduction in fluid capacity of the reservoir can easily be compensated by a small increase in the external dimensions of the reservoir. If the increase is in all three dimensions, a minimum increase is sufficient to replace the volume lost by incorporation of the component.

It is particularly advantageous if all the components which it is possible to incorporate in the reservoir are wholly incorporated in it, as a substantial space saving by the removal of those components from their previous locations is offset by only a minimal increase in the size of the reservoir. This provides an extremely compact fluid-pressure actuating system which can be installed in motor vehicles with minimum available space.

Additionally, incorporation of components into the reservoir can influence the flow relationship in a positive manner by appropriate shaping and dimensioning of the component. Preferably the dimensions of at least one incorporated component are chosen in relation to the dimensions of the reservoir to provide at least one constriction between the reservoir wall and the surface of the component, the or each constriction having an effect on the velocity of flow of the pressure fluid.

The constrictions provide a kind of throttle point or restriction in the reservoir, by which the velocity of flow of the fluid can be influenced for critical vehicle movements and vehicle attitudes. This helps to maintain a constant fluid level, so that the suction side of the pump is always immersed in the fluid, thereby avoiding any unwanted suction of air. Further, reducing movement of the fluid within the reservoir reduces the formation of foam on the fluid, which can arise when fluid returns from the system into the reservoir. The velocity of flow of the returning fluid can be reduced by narrowing the clearance between the reservoir wall and the associated surface of the incorporated component, in order to reduce the foaming of the fluid.

The advantageous effect obtained by the narrowing can be put to particularly good use when the accumulator is incorporated in the reservoir, and the accumulator and the reservoir are each of circular cross-section in the same set of parallel planes.

The axes of the reservoir and the accumulator which extend perpendicular to these planes may be spaced apart or coincident. Assuming that the geometry of the reservoir and the accumulator are complementary, where the axes are spaced, the spacing between the reservoir wall and the surface of the accumulator changes round the

periphery. Where the axes coincide, there is an annular constriction of constant width between the reservoir wall and the accumulator. As a consequence of this, spacing of the axes causes different throttling effects at different points of the reservoir, whilst with the coincident axes the throttling action achieved by the constriction is constant.

Of course, the profile of either the accumulator or the reservoir may vary along its axis, in order to provide an axial variation in the constriction, and thus the throttling effect achieved.

Conveniently, the reservoir has a volume which results from the sum of the volume enclosed by a comparable reservoir without an incorporated component and the volume displacement of this component. This gives an advantageous dimensioning of the reservoir by which it is suitable for receiving at least one component without any loss of the space available for the fluid and with the least possible increase in its external measurements.

An embodiment of the invention by way of example is illustrated in the accompanying drawings, in which

Figure 1 is a diagrammatic illustration of an automatic clutch-actuating system for a motor vehicle friction clutch with hydraulic actuation; and

Figure 2 is a partially sectioned side view of the system of Figure 1.

Figure 1 shows diagramatically a friction clutch 1 arranged in a conventional manner between engine and gearbox of a motor vehicle (not

shown). The clutch 1 has a withdrawal system 3 actuated in the direction of release of the clutch by an hydraulic actuating cylinder 5 comprising a fluid-pressure actuator means of a fluid-pressure actuating system. The system comprises a pump 22 with its suction side in a reservoir 17, drive means 25 for operating the pump 22, an accumulator 20 supplied by the pump 22, and a control valve 12 for controlling the connection of the cylinder 5 to the accumulator 20 and the reservoir 17.

The piston 6 of the actuating cylinder 5 has an associated position sensor 8 which is formed by a potentiometer and is connected to a control means 10 by which the clutch 1 is automatically engaged and disengaged in a manner known in itself in accordance with the driving situation of the vehicle, both on starting off and also on a change of ratio in a gear-change system (not shown). The control means 10 responds to a signal from the position sensor 8 representing the current position of the piston 6 and thereby the current position of the withdrawal mechanism 3 of the clutch 1, and acts through the control valve 12 to provide in a pressure space 11 of the actuating cylinder 5 a pressure proportional to the desired position of the withdrawal mechanism 3.

The control valve 12, which is a three/three-way proportional valve, is urged by a return spring 13 into the position illustrated in Figure 1, in which it connects the pressure space 11 through a return pipe 15 to the reservoir 17 for the pressure fluid. When an electromagnetic actuating member 18 of the valve 12 is energised the latter is opened partially or wholly, depending on the exciting current, connecting the pressure space 11 to the accumulator 20. The degree of opening of the valve 12 is determined by the control means 10 so that a desired position of the withdrawal mechanism 3 is maintained, corresponding to the driving situation of the vehicle. The accumulator 20 is connected through

a non-return valve 23, which opens in the pressure direction of the pump 22, to the pump 22 delivering fluid from the reservoir 17 and driven by the drive means 25 which comprises an electric motor The motor 25 is supplied from the vehicle wiring system. An excess pressure valve 27 connected to the pressure side of the pump 22 and leading back to the reservoir 17 protects the system from overload.

As shown in detail in Figure 2, the pump 22, control valve 12, accumulator 20 and motor 25 are combined with the reservoir 17 to form a drive module 30 which can be mounted in the vehicle as a unit. In the module 30, the suction side of the pump 22, and the valve 27 project into the reservoir 17, and the accumulator 20 is incorporated wholly in the reservoir 17. The reservoir 17 and the accumulator 20 are each of circular cross-section in the same set of parallel planes, which are perpendicular to their central axes 32, 33, the axis 32 applying to the reservoir 17 and the axis 33 to the accumulator 20. The reservoir 17 has a substantially constant internal profile along its axis 32, while the accumulator 20 has a varying profile along its axis 33. The axes are parallel to the longitudinal axis of the drive means 25 for the pump 22 and are arranged spaced apart. This gives, round the peripheral surface of the accumulator 20, a continuously changing spacing with respect to the associated part of a wall 35 of the reservoir 17. The free space between the outside of the accumulator 20 and the inside of the reservoir 17 forms a constriction 37, by which fluid in the reservoir 17 is restricted as it flows out. The amount of the restriction depends on the width of the constriction 37, as it varies because of the eccentric disposition of the accumulator 20 within the reservoir 17. The constriction 37 is wider on the side from which the pump 22 sucks fluid than on the opposite side so that the suction of fluid is restricted as little as possible, which is advantageous. In contrast to this, the constriction 37 on the opposite side

of the accumulator 20 is in the form of a gap which produces a particularly effective throttling action, to oppose any rapid movement of the fluid in the reservoir under the action of sudden movements of the vehicle. As a result of this gap-like throttle point an almost constant fluid surface level is achieved in the reservoir 17, so that the suction intake of the pump 22 is always immersed in the fluid and accordingly the danger of sucking air does not arise.

In a modification (not shown) the accumulator 20 can be arranged within the reservoir 17 in such a way that the axes 32 and 33 coincide. The annular constriction 37 around the accumulator 20 then has a constant width round its entire periphery. It will be appreciated that in Figure 2, the constriction 37 varies axially, as well as circumferentially, and indeed can be shaped to provide any required throttling action. It could also be substantially cylindrical, so that there is no axial variation in the constriction 37.

Furthermore it will be understood that the drive means 25 and/or the control valve 12 could also be incorporated in the reservoir 17, as in particular the actuating member 18 of the control valve 12 and the drive 25 are components of comparable size. The reservoir 17 must be of course made larger in order to compensate for the loss of volume resulting from the incorporation of any components. However, the increase in size can take place in three dimensions and a comparatively small increase in the overall size of the reservoir 17 is sufficient to compensate for the volume lost by the incorporation of any or all of the components 12, 22 and 25 within the reservoir 17. Incorporating the components in the reservoir is a particularly efficient way of saving space, as of course the fluid takes up all the remaining space in the reservoir. The reduction in the size of the system by the removal of the

components 12, 20 or 25 from their usual positions is much greater than the slight increase in the size of the reservoir 17, so that the overall size of the system is substantially reduced. The system also has a very compact structure, so that it can be installed in motor vehicles which have very little space available.

CLAIMS

1. A fluid-pressure actuating system of the kind set forth, in which at least one of the components comprising drive means, accumulator and control valve is at least partially incorporated in the reservoir.

2. A fluid-pressure actuating system as claimed in claim 1, in which at least one of the components is wholly incorporated in the reservoir.

3. A fluid-pressure actuating system as claimed in claim 1 or claim 2, in which the dimensions of at least one incorporated component are chosen in relation to the dimensions of the reservoir to provide at least one constriction between the reservoir wall and the surface of the component, the or each restriction having an effect on the velocity of flow of the pressure fluid.

4. A fluid-pressure actuating system as claimed in any preceding claim, in which the accumulator is incorporated in the reservoir, and the accumulator and the reservoir are each of circular cross-section in the same set of parallel planes.

5. A fluid-pressure actuating system as claimed in claim 4, in which the axes of the reservoir and the accumulator which extend perpendicular to these planes are spaced apart.

6. A fluid-pressure actuating system as claimed in claim 4, in which the axes of the reservoir and the accumulator which extend perpendicular to these planes are coincident.

7. A fluid-pressure actuating system as claimed in any of claims 4 to 6, in which the profile of at least one of the reservoir and the accumulator varies along its axis.

8. A fluid-pressure system as claimed in any preceding claim, in which the reservoir has a volume which results from the sum of the volume enclosed by a comparable reservoir without an incorporated component and the volume displacement of this component.

9. A fluid-pressure actuating system of the kind set forth substantially as described herein with reference to and as illustrated in the accompanying drawings.

The Patent Office

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Application No: GB 9609447.9 **Examiner:** Trevor Berry
Claims searched: 1 to 9 **Date of search:** 12 September 1996

Patents Act 1977
Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.O): F1D, F1P, G3P (PPSS)

Int Cl (Ed.6): F15B

Other:

Documents considered to be relevant:

Category	Identity of document and relevant passage		Relevant to claims
X	GB 1456183	Aisin Seiki-note accumulator 15 in figure 1	1, 2 ,4, 6, 7, 8
X	GB 0951102	Girling-note accumulator 7	1, 2, 8
X	WO 95/02769 A1	ZF-note accumulator 1	1-4, 6-8
X	US 5104294	Showa Seisakusho-note motor 19 in fig 3	1, 2, 8
X	US 4924670	General Motors-note motor 50	

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
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